

CLAIMS

What is claimed is:

1. A method of forming a horizontal bore in an earth formation comprising:
 - a) forming a pilot bore of a first select diameter along a desired path of a horizontal bore;
 - b) inserting a grindable casing into the pilot bore;
 - c) flowing a cryogenic fluid through the grindable casing to form a freeze zone of frozen moisture adjacent to the grindable casing having a second select diameter; and
- 10 d) forming a primary bore having a third select diameter greater than the first select diameter and less than the second select diameter within the freeze zone along the desired path of the horizontal bore with the grindable casing in place, the second select diameter being sufficiently greater than the third select diameter to prevent collapse of the primary bore.
- 15 2. The method of claim 1 wherein step a) is performed using a directionally controlled drill string driven by a cryogenic fluid.
3. The method of claim 1 further comprising:
 - 20 e) installing a screen or gravel pack and screen within a portion of the primary bore while the freeze zone remains sufficiently frozen to prevent collapse of the portion of the primary bore.
4. The method of claim 1 wherein steps a)-d) are performed from a ground surface overlying the earth formation and the horizontal bore includes a transverse portion transverse to the ground surface and a substantially horizontal portion substantially parallel to the ground surface.
5. The method of claim 4 further comprising:

e) installing a screen or gravel pack and screen in the substantially horizontal portion of the primary bore while the freeze zone remains sufficiently frozen to prevent collapse of the primary bore.

5 6. The method of claim 5 further comprising:

f) installing a casing between the ground surface and the screen.

7. The method of claim 6 further comprising:

g) installing a submersible pump in one of the transverse portion or the

10 substantially horizontal portion.

8. The method of claim 5 further comprising:

f) providing a vertical shaft between the ground surface and the substantially horizontal portion of the primary bore; and

15 g) providing a pump proximate an intersection between the vertical shaft and the substantially horizontal portion of the primary bore.

9. The method of claim 4 wherein in step c) the second select diameter defines a freeze zone of sufficient structural integrity to withstand mechanical forces of a
20 directional drill string used in step d) as the primary bore transitions from the transverse portion to the substantially horizontal portion without collapse of the primary bore.

10. The method of claim 1 further comprising:

e. installing geotechnical instrumentation in the primary bore.

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11: The method of claim 1 further comprising:

e. collecting soil or stabilized fluid samples in solid form from the earth
ion.

12. A method of forming a horizontal bore in an earth formation comprising:

- a) providing a drill string having a conduit communicating with a cutting tool for engaging the earth formation;
- b) flowing a cryogenic fluid through the conduit and the cutting tool to drive the cutting tool and remove cuttings from a bore formed by the cutting tool;
- c) directing the cutting tool into an earth formation;
- d) forming a freeze zone in the earth formation in advance of the cutting tool with the cryogenic fluid flowing through the cutting tool; and
- e) advancing the cutting tool into the earth formation to form the bore at a rate enabling continuous formation of a freeze zone in advance of the cutting tool.

13. The method of claim 12 further comprising initially directing the cutting tool into the earth formation at a ground surface above the earth formation and in step e) advancing the cutting tool to form a transverse portion of the horizontal bore transverse to the ground surface and a substantially horizontal portion of the horizontal bore substantially parallel to the ground surface.

14. The method of claim 13 wherein the freeze zone is formed of sufficient diameter to prevent collapse of the bore.

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15. The method of claim 13 wherein the freeze zone has sufficient structural integrity to withstand mechanical forces of the drill string as the bore transitions from the transverse portion to the substantially horizontal portion without collapse of the bore.

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16. The method of claim 13 further comprising installing a screen or gravel pack and screen within the substantially horizontal portion of the bore while the freeze zone remains sufficiently frozen to prevent collapse of the substantially horizontal portion of the bore.

17. The method of claim 16 further comprising installing a submersible pump in either the transverse portion or the substantially horizontal portion of the bore.

18. The method of claim 16 further comprising providing a vertical shaft 5 between the ground surface and the substantially horizontal portion of the bore and providing a pump proximate an intersection between the vertical shaft and the substantially horizontal portion of the bore.

19. The method of claim 16 further comprising:
10 f) installing casing between the ground surface and the screen.